Molecules in nanopores as a model system for mimicking spreading in nature and society

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Phenomena of diffusive spreading are ubiquitous in our world. They may be observed in nature and society, with reference to both material and immaterial objects. Examples range from the irregular movement of atoms and molecules as the elementary constituents of matter in gases, liquids and solids (with dramatically differing rates of propagation) up to the spreading of deceases and the incorporation of new words in our language [1]. Investigating molecular mass transfer within nanoporous materials is, within this context, distinguished by a number of advantages. They refer to both the objects of spreading and the conditions under which spreading occurs. On considering molecules, one operates, as a rule, with an extremely large amount of diffusants. All molecules of a given species are identical – and do (at least under conditions excluding chemical reactions) not change their identity with time. By observing mass transfer within a host system of well-defined architecture one has exact knowledge of the conditions under which mass transfer has to occur, with the option of a well-defined variation of these conditions by provident, purposeful chemical processing, ending up in well-defined changes in host structure and, hence, the propagation conditions. Compared with most of other studies, investigating molecular spreading in nanopores thus affords high statistical relevance, extended options for varying the initial and boundary conditions, high reproducibility and good prospects, given all these options, to end up with simple relations for quantitating the overall phenomena.

With reference to these advantages, the poster goes the other way round and identifies a couple of similarities where, on looking at molecular diffusion in nanoporous materials, one is able to recognize features of spreading, which may occur in quite different fields of research. The examples presented include

(i) considering molecular uptake and release with nanoporous particles as a model for, respectively, occupation of a habitat by a new species and, vice versa, for the loss of a species in this habitat [2],

(ii) the effect of additional highways on overall mass transfer [3,4],

(iii) transport impediment (and enhancement!) by diffusant interference [5],

(iv) invader-induced changes in the host system [2] and

(v) host-induced changes of the invaders [6].

References

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